DETAILED ACTION

Claim Rejections - 35 USC § 103

1.   The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148

USPQ 459 (1966), that are applied for establishing a background for determining

obviousness under 35 U.S.C. 103(a) are summarized as follows:

    1.   Determining the scope and contents of the prior art.
    2.   Ascertaining the differences between the prior art and the claims at issue.
    3.   Resolving the level of ordinary skill in the pertinent art.
    4.   Considering objective evidence present in the application indicating
           obviousness or nonobviousness.

2.   Claims 38-55, 72, 75, and 78-96 rejected under 35 U.S.C. 103(a) as being

unpatentable over Yang et al (US 5,453,799, hereafter Yang) in view of Aono et al (US

5,859,668).

    As per **claim 38**, Yang discloses a coding mode determining apparatus for

determining at least one of a plurality of candidate coding modes of an image block, the

coding mode determining comprising:

    a simple motion estimation portion that derives a first coding cost for each of the

plurality of coding modes, based on a simple motion estimation for small blocks, the

small motion blocks being partitions of the image block obtained using each of the

plurality of coding modes (column 5 lines 10 – 21);

a coding mode selecting portion that selects a subset of the plurality of coding

modes, based on the first coding cost derived for each of the plurality of coding modes

by the simple motion estimation portion (column 5 lines 5 – 40);

a complex motion estimation portion that derives a second coding cost for each

of the plurality of coding modes, based on a complex motion estimation for the small

blocks obtained using at least a subset of the selected subset of the plurality of coding

modes (column 5 lines 21 – 38); and

a coding mode determining portion that determines, from the plurality of coding

modes, a coding mode of the image block, the coding mode being determined based on

the second coding cost derived for each of the plurality of coding modes by the complex

motion estimation portion (column 5 lines 5 - 40).

However, Yang does not explicitly teach wherein the complex motion estimation

portion determines a picture reference direction used in the complex motion estimation,

the picture reference direction being determined based on the simple motion estimation,

and the picture reference direction being a prediction direction, and wherein, based on

the simple motion estimation for the small blocks, the complex motion estimation portion

derives the second coding cost (i) by selecting both a forward prediction direction and a

backward prediction direction, when both the forward prediction direction and the

backward prediction direction result in substantially a same coding cost, and (ii) by

selecting one of the forward direction and the backward prediction direction resulting in

a small coding cost, when the forward prediction direction and the backward prediction

direction result in a different coding cost.

In the same field of endeavor, Aono discloses wherein the complex motion

estimation portion determines a picture reference direction used in the complex motion

estimation, the picture reference direction being determined based on the simple motion

estimation, and the picture reference direction being a prediction direction, and wherein,

based on the simple motion estimation for the small blocks, the complex motion

estimation portion derives the second coding cost (i) by selecting both a forward

prediction direction and a backward prediction direction, when both the forward

prediction direction and the backward prediction direction result in substantially a same

coding cost, and (ii) by selecting one of the forward direction and the backward

prediction direction resulting in a small coding cost, when the forward prediction

direction and the backward prediction direction result in a different coding cost (column

8 lines 31-55).

Therefore, it would have been obvious for one of ordinary skill in the art at the

time of the invention to modify the invention of Yang in view of Aono. The advantage is

finding the optimum prediction mode (column 8 lines 53-56).

As per **claim 39**, Yang discloses the coding mode determining apparatus

according to claim 38, wherein, when deriving the first coding cost of each of the

plurality of coding modes, the simple motion estimation portion performs the simple

motion estimation in a plurality of picture reference directions on each of the small

blocks obtained using each of the plurality of coding modes to calculate a coding cost,

then (ii) selects a picture reference direction having a lowest coding cost for each

individual small block, then (iii) sums up the first coding costs derived for all of the small

blocks relating to the selected picture reference direction for each of candidate division

methods individually to derive the first coding cost of the coding mode of each of the

candidate division methods (column 5 lines 5 - 40).

As per **claim 40**, Yang discloses the coding mode determining apparatus

according to claim 38, wherein, when deriving the first coding cost of each of the

plurality of coding modes, the simple motion estimation portion performs a simple

motion estimation in a plurality of picture reference directions on each of the small

blocks obtained with each of the coding modes to calculate a coding cost, then converts

the coding cost of each of the small blocks for each picture reference direction

individually into a coding cost per image block to derive a coding cost of the coding

mode of each of candidate division methods for each of the reference directions

(column 5 lines 5 - 40).

As per **claim 41**, Yang discloses the coding mode determining apparatus

according to claim 39.

However, Yang does not explicitly teach wherein the simple motion estimation in

the plurality of picture reference directions in the simple motion estimation portion

includes only the forward prediction direction in which a temporally preceding picture is

referenced, and backward prediction direction in which a temporally following picture is referenced.

In the same field of endeavor, Aono teaches wherein the simple motion estimation in the plurality of picture reference directions in the simple motion estimation portion includes only the forward prediction direction in which a temporally preceding picture is referenced, and backward prediction direction in which a temporally following picture is referenced (column 8 lines 31-55).

Therefore, it would have been obvious for one of ordinary skill in the art at the time of the invention to modify the invention of Yang in view of Aono. The advantage is finding the optimum prediction mode (column 8 lines 53-56).

Regarding **claim 42**, arguments analogous to those presented for claim 41 are applicable for claim 42.

As per **claim 43**, Yang discloses the coding mode determining apparatus according to claim 39.

However, Yang does not explicitly teach wherein the simple motion estimation in the plurality of picture reference directions in the simple motion estimation portion includes forward prediction in which a temporally preceding picture is referenced, the backward prediction in which a temporally following picture is referenced, and a bi-directional prediction direction in which pictures that are on both sides in time are referenced.

In the same field of endeavor, Aono discloses wherein the simple motion estimation in the plurality of picture reference directions in the simple motion estimation portion includes forward prediction in which a temporally preceding picture is referenced, the backward prediction in which a temporally following picture is referenced, and a bi-directional prediction direction in which pictures that are on both sides in time are referenced (column 8 lines 31-55).

Therefore, it would have been obvious for one of ordinary skill in the art at the time of the invention to modify the invention of Yang in view of Aono. The advantage is finding the optimum prediction mode (column 8 lines 53-56).

Regarding **claim 44**, arguments analogous to those presented for claim 43 are applicable for claim 44.

As per **claim 45**, Yang discloses the coding mode determining apparatus according to claim 39, wherein the simple motion estimation in a plurality of picture reference directions in the simple motion estimation portion includes forward prediction in which a temporally preceding picture is referenced, and backward prediction in which a temporally following picture is referenced, and wherein the simple motion estimation portion derives a coding cost where bi-directional prediction in which pictures that are on both sides in time are referenced is performed, based on the forward prediction and the backward prediction (column 5 lines 5 - 40).

Regarding **claim 46**, arguments analogous to those presented for claim 45 are applicable for claim 46.

As per **claim 49**, Yang discloses the coding mode determining apparatus according to claim 38, wherein the complex motion estimation portion selects at least a further subset of the selected subset of the plurality of coding modes, based on the simple motion estimation for the small blocks (column 5 lines 5 - 40).

As per **claim 50**, Yang discloses the coding mode determining apparatus according to claim 49, wherein the complex motion estimation portion (i) selects each of the plurality of coding modes in an ascending order of the first coding cost, (ii) derives the second coding cost by repeatedly selecting coding modes of the plurality of coding modes in the ascending order of the first coding cost, while a sum of a processing amount of the selected coding mode does not exceed a margin for the processing amount, and (iii) stops selecting coding modes when the sum of the processing amount of the selected coding modes exceeds the margin for the processing amount, and does not derive the second coding cost after a time when the sum of the processing amount of the selected coding modes exceeds the margin for the processing amount (column 5 lines 5 - 40).

As per **claim 51**, Yang discloses the coding mode determining apparatus according to claim 38, wherein the simple motion estimation portion changes, depending on an image attribute, a method of motion estimation in the simple motion estimation in such a manner that a processing amount for the simple motion estimation remains substantially constant (column 5 lines 5 – 40 and column 6 lines 38 - 47).

As per **claim 52**, Yang discloses the coding mode determining apparatus according to claim 38, wherein the simple motion estimation is motion estimation having integer pixel accuracy, and wherein the complex motion estimation is motion estimation having non-integer pixel accuracy (column 5 lines 5 - 40).

As per **claim 53**, Yang discloses an integrated circuit comprising the coding mode determining apparatus according to claim 38 (column 5 lines 5 - 40).

As per **claim 54**, Yang discloses an image coding apparatus comprising: the coding mode determining apparatus according to claim 38; and a coding apparatus that codes an image block, based on a coding mode of the image block that is determined by the coding mode determining apparatus (column 5 lines 5 - 40).

As per **claim 55**, Yang discloses an integrated circuit comprising the image coding apparatus according to claim 54 (column 4 lines 40 - 55).

Regarding **claim 72**, arguments analogous to those presented for claim 38 are applicable for claim 72.

Regarding **claim 75**, arguments analogous to those presented for claim 38 are applicable for claim 75.

As per **claim 78**, the coding mode determining apparatus according to claim 38, wherein the complex motion estimation portion performs the complex motion estimation by selecting each of the plurality of coding modes (i) in an ascending order of the first coding cost and (ii) within a range in which a sum of a processing amount of the plurality

of coding modes does not exceed an allowable value of the image block (column 5 lines 5 - 40).

As per **claim 79**, Yang disclose the coding mode determining apparatus according to claim 78, wherein the processing amount is determined, such that the processing amount is proportional to a pixel number of a small block of the image block (column 6 lines 35 - 50).

As per **claim 80**, Yang discloses the coding mode determining apparatus according to claim 78, wherein the processing amount is determined, such that the processing amount is proportional to a number of picture reference directions (column 5 lines 5 – 40 and column 6 lines 35-50).

As per **claim 81**, Yang discloses the coding mode determining apparatus according to claim 80, wherein the processing amount is determined, such that the processing amount is proportional to the number of picture reference directions derived by:

not counting picture reference directions when the simple motion estimation in the plurality of picture reference directions is performed through a bi-directional prediction direction, in which pictures that are on both sides in time are referenced; and counting picture reference directions when the simple motion estimation in the plurality of picture reference directions is performed through a prediction direction, other than the bi-directional prediction direction in which pictures that are on both sides in time are referenced (column 5 lines 5 – 40 and column 6 lines 35 - 50).

As per **claim 82**, Yang discloses the coding mode determining apparatus according to claim 38, wherein the complex motion estimation portion changes, depending on an image attribute, a method of motion estimation in the complex motion estimation in such a manner that a processing amount for the complex motion estimation remains substantially constant (column 5 lines 5 - 40).

As per **claim 83**, Yang discloses the coding mode determining apparatus according to claim 38, wherein the simple motion estimation portion and the complex motion estimation portion respectively change, depending on an image attribute, a method of motion estimation in such a manner that a sum of a processing amount for the simple motion estimation by the simple motion estimation portion and a processing amount for the complex motion estimation by the complex motion estimation portion remains substantially constant (column 5 lines 5 – 40).

As per **claim 84**, Yang discloses the coding mode determining apparatus according to claim 51, wherein the image attribute is at least one of (i) a size of the image block, (ii) a coding method for a picture type, including I-picture, P-picture, and B-picture, of the image block, (iii) a format for a scanning method, including progressive and interlaced, and a chroma format of the image block, and (iv) a motion amount of the image block (column 6 lines 38 - 67).

Regarding **claim 85**, arguments analogous to those presented for claim 84 are applicable for claim 85.

Regarding **claim 86**, arguments analogous to those presented for claim 84 are applicable for claim 86.

As per **claim 87**, Yang discloses the coding mode determining apparatus according to claim 84, wherein at least one of the simple motion estimation portion and the complex motion estimation portion changes a method of motion estimation in the simple motion estimation and the complex motion estimation, such that a product of a size of an input image constituted by the image block, a number of reference pictures and a number of partition sizes remain substantially constant (column 6 lines 38 - 67).

As per **claim 88**, Yang discloses the coding mode determining apparatus according to claim 84, wherein at least one of the simple motion estimation portion and the complex motion estimation portion renders a number of reference pictures for B-pictures smaller than those for P-pictures, such that the processing amount for the simple motion estimation and the complex motion estimation for each picture remains substantially constant (column 6 lines 38 - 67).

As per **claim 89**, Yang discloses the coding mode determining apparatus according to claim 84, wherein at least one of the simple motion estimation portion and the complex motion estimation portion keeps the processing amount for the simple motion estimation and the complex motion estimation constant for each picture through one of the following:

at least one of the simple motion estimation portion and the complex motion estimation portion references a preceding four pictures for P-pictures, and references a preceding two pictures and a subsequent two pictures for B-pictures;

at least one of the simple motion estimation portion and the complex motion estimation portion references a preceding three pictures for P-pictures, and references a preceding two pictures and a subsequent one picture for B-pictures; and

at least one of the simple motion estimation portion and the complex motion estimation portion references a preceding two pictures for P-pictures, and references a preceding one picture and a subsequent one picture for B-pictures (column 6 lines 38 - 67).

As per **claim 90**, Yang discloses the coding mode determining apparatus according to claim 84, wherein at least one of the simple motion estimation portion and the complex motion estimation portion renders a number of partition sizes of B-pictures smaller than that of P-pictures, such that the processing amount for the simple motion estimation and the complex motion estimation for each picture remains substantially constant (column 6 lines 38 - 67).

As per **claim 91**, Yang discloses the coding mode determining apparatus according to claim 84, wherein at least one of the simple motion estimation portion and the complex motion estimation portion keeps the processing amount for the simple motion estimation and the complex motion estimation constant for each picture through one of the following:

at least one of the simple motion estimation portion and the complex motion estimation portion (A) references a preceding one picture for P-pictures, and performs a prediction for four partition sizes of 16x16, 16x8, 8x16 and 8x8, and (B) selects two of the above-described four partition sizes for B-pictures, and performs forward prediction

and backward prediction for both of the selected two; and at least one of the simple

motion estimation portion and the complex motion estimation portion (C) references a

subsequent one picture for P-pictures, and performs a prediction for four partition sizes

of 16x16, 16x8, 8x16 and 8x8, and (D) selects two of the above-described four partition

sizes for B-pictures, and performs forward prediction and backward prediction for both

of the selected two (column 6 lines 38 - 67).

As per **claim 92**, Yang discloses the coding mode determining apparatus

according to claim 84, wherein at least one of the simple motion estimation portion and

the complex motion estimation portion renders a number of reference pictures or a

number of partition sizes when an input image is an interlaced image smaller than the

number of reference pictures or the number of partition sizes when the input image is a

progressive image (paragraph [0055]).

As per **claim 93**, Yang discloses the coding mode determining apparatus

according to claim 84, wherein at least one of the simple motion estimation portion and

the complex motion estimation portion:

in a case of P-pictures, references a preceding two frames for progressive P-

pictures, and references a preceding two fields for interlaced P-pictures; and in the case

of P-pictures, (A) references a preceding one frame for progressive P-pictures, and

performs a prediction for each of four types of partition sizes of 16x16, 16x8, 8x16 and

8x8, and (B) references a preceding two fields for interlaced P-pictures, and performs a

prediction for two types of the partition sizes for each of selected two partition sizes

(column 6 lines 38 - 67).

As per **claim 94**, Yang discloses the coding mode determining apparatus

according to claim 84, wherein at least one of the simple motion estimation portion and

the complex motion estimation portion changes a number of reference pictures or a

number of partition sizes, in accordance with a motion of the image block (column 6

lines 38 - 67)

As per **claim 95**, Yang discloses the coding mode determining apparatus

according to claim 50, wherein the processing amount is determined, such that the

processing amount is proportional to a pixel number of a small block of the image block

(column 6 lines 38 - 67)

As per **claim 96**, Yang discloses the coding mode determining apparatus

according to claim 50, wherein the processing amount is determined, such that the

processing amount is proportional to a number of picture reference directions (column 6

lines 38 - 67)

Conclusion

Any inquiry concerning this communication or earlier communications from the

examiner should be directed to CHIKAODILI E. ANYIKIRE whose telephone number is

(571)270-1445. The examiner can normally be reached on Monday to Friday, 7:30 am

to 5 pm, EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, Chris Kelley can be reached on (571) 272 - 7331. The fax phone number

for the organization where this application or proceeding is assigned is 571-273-8300.

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